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(54) Self-contained, transportable apparatus provided with ventilating and air conditioning systems which guarantees the continuous power supply to one or more users.

(57) A self-contained, transportable apparatus provided with ventilating and air conditioning systems for assuring the continuous power supply to one or more users which has small overall dimensions and can be installed both inside and outside the user's facilities to be supplied. The apparatus consists of a compact self-supporting container or shelter in which the units capable of assuring a continuous power supply such as an inverter, a generating set, an accumulator battery with relative recharge and control unit are assembled. Such units are located in separate sections, one of which, the socalled warm side, and including the generating set, makes use of the same fans of the engine and the alternator for ventilating and intaking from the outside air currents conveyed through separate channels to the warm parts of the units to be cooled, the other section, the socalled cold side, makes use of a refrigerating system using a freezing fluid.

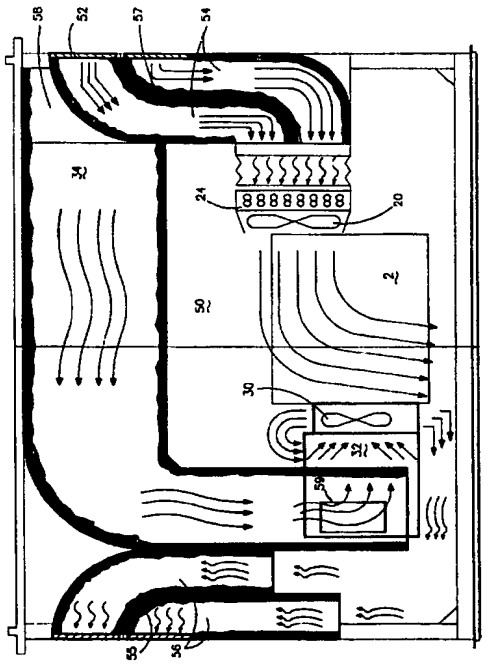

FIG. 4

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This invention relates to a self-contained apparatus for the continuous power supply of one or more users which features small overall dimensions, fast installation, and effective soundproofing, and includes in combination an inverter, a generating set, an accumulator battery with relative buffer control and recharge unit, and a ventilating and air conditioning system.

The described apparatus appears in the form of a self-supporting container or shelter of restricted dimensions which can then be easily transported and located both inside and outside the facilities to which it is to be connected.

With the increasing utilization of electronics in a number of productive activities the need to guarantee a steady power supply even during a circuit transient, microbreak, power failure or blackout is of primary importance.

At present this is done by placing a number of single commercially available apparatus such as an inverter, a generating set, and an accumulator battery provided with control and recharge unit in parallel between mains and user. However, the installation of such apparatus has a number of drawbacks: the different units have to be assembled by hand; once such units have been assembled, they cannot be moved without dismantling them; in addition, they are cumbersome and noisy making it difficult to assemble them inside a building.

In Italian Patent No. 1208678 of the same Applicant, an apparatus for continuously supplying power has been disclosed in which all of the above mentioned units are placed within one compact, transportable, heat insulated, soundproof container or shelter. In order to keep the inner temperature under control the use of a ventilating and air conditioning system is provided.

Despite the obvious advantages of such an apparatus, its usage has displayed a number of limitations.

First of all, the use of air from outside for properly ventilating the uninterruptible power system (UPS) proved impossible as the sophisticated electronics of the latter suffer the presence of any dust entrained by the air.

In addition, the ventilating and air conditioning system requires excessive energy and space.

The present invention seeks to avoid the above mentioned drawbacks by improving the efficiency of the ventilating and air conditioning system, reducing the overall dimensions, and assuring to the UPS a proper air circulating system which prevents outside dust from being let in.

This has been achieved by the following arrangements:

each subassembly of the apparatus (generating set, inverter, accumulator battery and control units) is set apart in a suitable compartment provided with an access door for correct inspection; such compartments are shut up in two warm and cold sides of the shelter, completely separated from each other;

each fan of the engine and the alternator is used for independently intaking air from the outside through separate inlets for cooling its relative subassembly. In particular, the fan of the engine has the function of air-cooling the parts of the diesel engine, while the fan of the alternator cools the generating set. The cooling air of the diesel engine intaken from the outside through labyrinth channels laps the alternator and is conveyed into an outlet labyrinth of the shelter. The alternator receives fresh air from the outside through a feed channel and expels warm air to the main current of the cooling air of the engine;

in the compartment of the UPS the heat produced by the inverter is exhausted by an intake fan of warm air which lets air into a closed-circuit ventilating system without connection to the outside. The heat is used for heating a gas in a condenser which is then compressed to be conveyed to a heat exchanger or evaporator where it expands according to an adiabatic process expelling heat to the outside through another fan.

Further features and advantages of the invention will be more readily apparent from the following description with reference to the accompanying drawings which illustrate a non-limitative example of a preferred embodiment of the invention.

In the drawings:

Fig. 1 is a perspective view of the front side of the apparatus in a closed container or shelter;

Fig. 2 is a perspective view of the rear side of the same;

Fig. 3 is a block diagram of the apparatus;

Fig. 4 is a diagram of the ventilation air flows of the apparatus on the engine-alternator side;

Fig. 5 is a diagram of the air flows of the air conditioning system of the uninterruptible power system;

Fig. 6 shows the inner compartments of the front side of the shelter;

Fig. 7 shows the inner compartments of the rear side of the same.

With reference to Figs. 3, 6 and 7 the apparatus according to the invention includes: a generating set (block GE) comprising an engine 2, its starter battery 4, and an alternator 6; an uninterruptible power system, generally known as UPS, comprising a rectifier 10, a static inverter 12, a static switch 16, and a manual bypass 18; an accumulator battery 14 for buffer purposes, and a control panel 8 also containing the logic circuits of the UPS and the generating set GE.

A possible remote control unit for controlling the apparatus is indicated at 9.

The assembly of such components is contained in a box-like construction 36 (Fig. 1) formed of strong self-supporting frame 38 which is closed by outer panels 40, secured so as to be removable, ar...

doors 42 that can be opened from the outside. The self-supporting frame is provided with eyebolts 44 for lifting purposes.

The described apparatus assures a continuous power supply as follows:

Under normal operating conditions load 19 is supplied by the mains through rectifier 10 and inverter 12. Rectifier 10 is intended to provide both the power necessary to the inverter and the automatic charge of the accumulator battery 14.

In case of power failure the buffer accumulator battery 14 operates instantaneously (zero time) so as to assure the absolute continuity of the supply, and the logic of control panel 8 operates the generating set which, under steady conditions, takes on the load through rectifier 10 and inverter 12.

When the power comes back the apparatus switches off to return to the mains operation.

The generating set checks through control panel 8 that the mains is supplying power, whereupon it switches off, assigning the load to the mains and restoring the original operating conditions without any power break. The rectifier automatically recharges the accumulator battery and at the same time supplies the inverter.

If the inverter breaks down or when the input voltage of the inverter is beyond the predetermined limits, the power supply of the user is instantaneously transferred through the static bypass switch to the safety network which assures the continuity of the power supply.

As can be seen in Figs. 6 and 7 the assembly which includes inverter and rectifier, the accumulator battery and the control panel, are located within the shelter in separated compartments accessible from the front side (cold side) through doors. The generating set is located at the rear side within a compartment which also contains a large catalytic muffler 45 for the treatment of the exhaust gases of the diesel engine.

The operation of inverter 12, engine 2 and alternator 6 involves the dissipation of a part of the produced energy into heat. In order to convey such heat to the outside the present invention resorts to the system illustrated in Figs. 4 and 5.

Engine 2, mounted in compartment 50 of the container or shelter, is cooled by an air current.' produced by fan 20 splined to the drive shaft 22. The air enters from air grating 52, is conveyed to the intake conduit 54, and crosses first water radiator 24, then the whole engine compartment 50 before being expelled into the atmosphere through conduit 56. Both intake conduit 54 and exhaust conduit 56 are soundproofed by a lining of foamed polyurethane and are internally separated by a partition 57, 55 which reduces the flow rate of the air current and improves the noise suppression. The length of the acoustic trap is sufficient to assure an acceptable noise level.

A fan 30 is splined to the shaft of alternator 6 and, besides causing air to circulate in engine compartment 50, takes air in from port 59 of another conduit 34 leading to an air grating 58 adjacent to air grating 52 already mentioned. Since port 59 opens near the alternator casing, the latter is in any case crossed by a current of fresh air which will always be at a lower temperature than that of engine compartment 50.

The fans of the engine and the alternator operate to keep the temperature of the warm side (rear side) of the shelter substantially constant, while inverter, rectifier, voltage control logic, control panel and accumulator battery are located in the cold side in three adjacent compartments which are thermally insulated from rear compartment 50 and are provided with their own ventilating and air conditioning system using quite independent air currents in order to avoid that the air circulating in the inverter compartment exceeds the temperature of 35-40°C and has a detrimental effect on the operation and the reliability. The system is shown in Fig. 5.

As seen in this figure, the air current produced by fan 61 within compartment 60 transmits heat to condenser 62 of a heat pump after having blown on inverter 12 and is recycled to the fan along a closed circuit without mixing in air from the outside. This allows any dust to be limited in the compartment of the inverter in order not to have a detrimental effect on the operation of the same. The heat transferred to condenser 62 liquefies the gas circulating in the latter which is subjected to an adiabatic compression and is fed through pipes (not shown) to evaporator 64 where it expands adiabatically transferring heat to the outside by an intake fan 66. Besides removing heat produced by evaporator 64, fan 66 takes in fresh air from the outside through port 74, thus assuring the ventilation of compartment 70 where the buffer accumulator battery and control panel 8 are located. On the other side, the cooled, expanded gas returns to condenser 62 and cools air circulating in the compartment of the UPS.

From the foregoing, the advantages of the apparatus according to the invention are self-evident:

- the subassemblies are contained in a shelter of reduced overall dimensions which can be immediately installed both inside and outside the user's facilities to Which it is to be connected;
- the temperature of the different compartments, as well as the noise level during the operation, is kept under acceptable limits in a fully reliable and economical way;
- the closed-circuit air circulation in the compartment of the inverter assures operation under any environmental conditions.

Claims

1. A self-contained, compact, transportable appara-

tus for the continuous power supply of one or more users, wherein it consists of a shelter including in combination a generating set, an inverter, an accumulator battery and a control unit monitoring the continuity of the power supply, all located in suitable compartments accessible from two opposite sides of the self-supporting structure of the shelter, said opposite sides being separated by a partition in a warm side and a cold side, a ventilating system being provided in the warm side using fans of the engine and the alternator of the generating set for producing two air currents which are independently intaken from the outside and separately conveyed to the inside for cooling the diesel engine and the generating set, respectively, a self-contained cooling system being provided in the cold side maintaining the temperature of the inverter and the voltage control units under 40°C.

2. The apparatus for the continuous power supply of one or more users as claimed in claim 1, characterized in that, in order to avoid that the inverter comes into contact with fine dust entrained by atmospheric air, the cooling system is provided with an intake fan which causes the warm air of the inverter compartment to circulate along a closed circuit so that said warm air transmits heat to a condenser in which a freezing fluid flows.

3. The apparatus for the continuous power supply of one or more users as claimed in any preceding claim, characterized in that the freezing fluid heated in the condenser is compressed and conveyed to an evaporator placed in the adjacent compartment of the cold side where it is subjected to an adiabatic expansion transferring heat to the outside of the shelter through a fan located in the same compartment.

4. The apparatus for the continuous power supply of one or more users as claimed in any preceding claim, characterized in that the exhaust gases of the diesel engine are conveyed to a catalytic muffler placed in the same compartment and provided with an exhaust to the outside.

5. The apparatus for the continuous power supply of one or more users as claimed in any preceding claim, characterized in that the conduits in which the ventilation air of the warm side is conveyed are provided with sound traps for soundproofing.

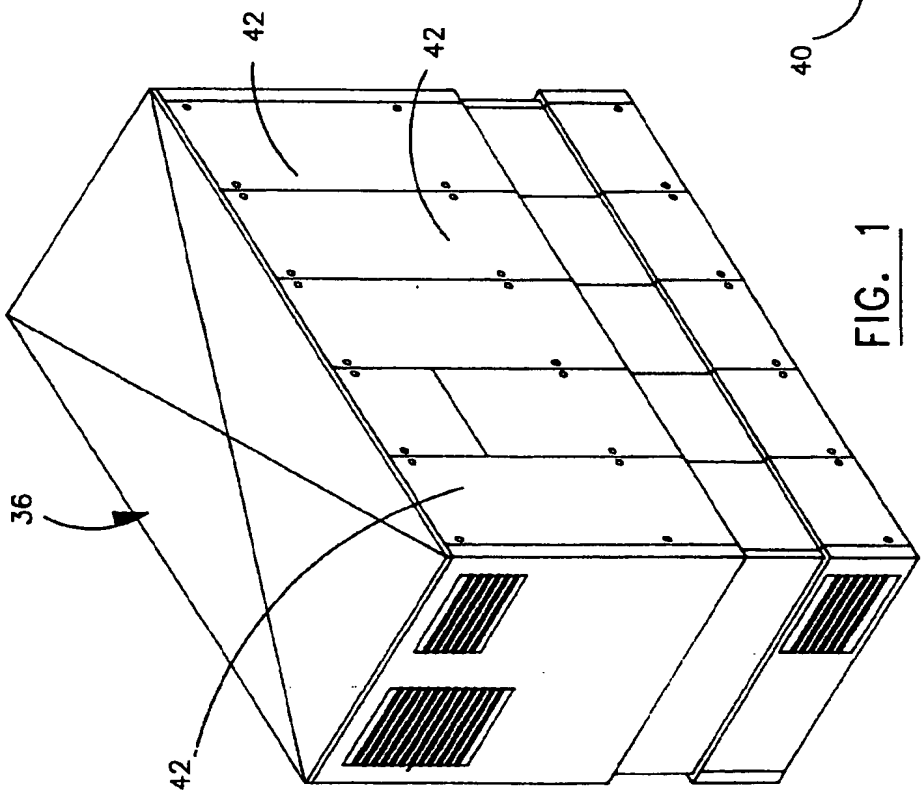

FIG. 1

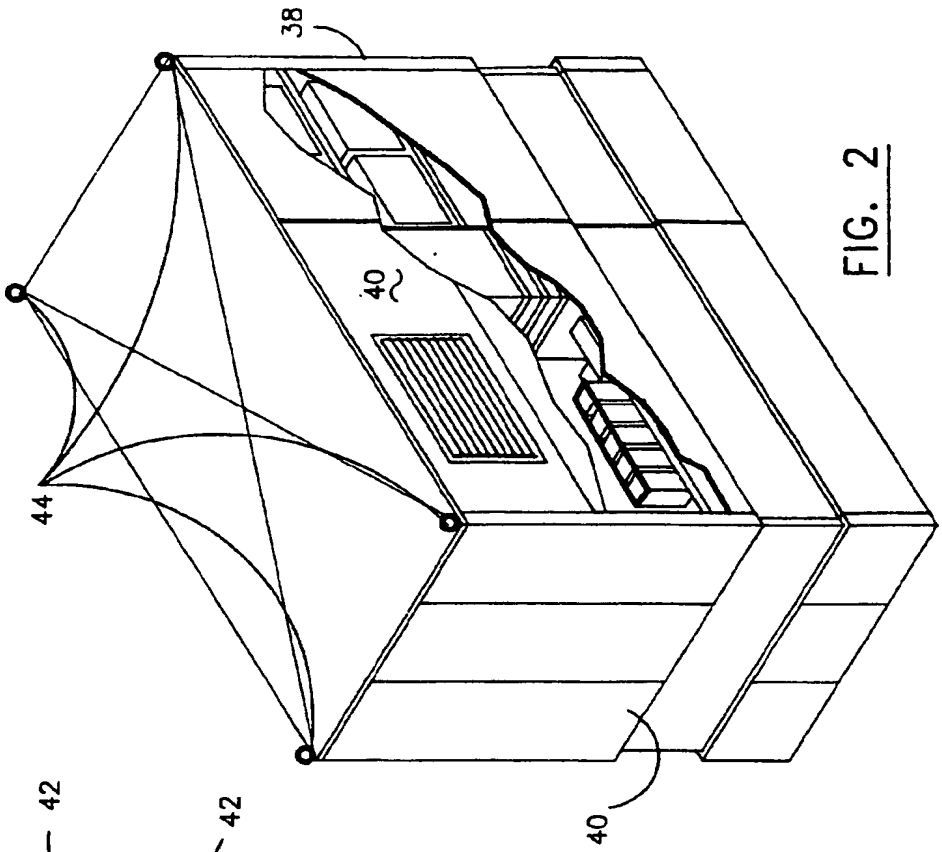

FIG. 2

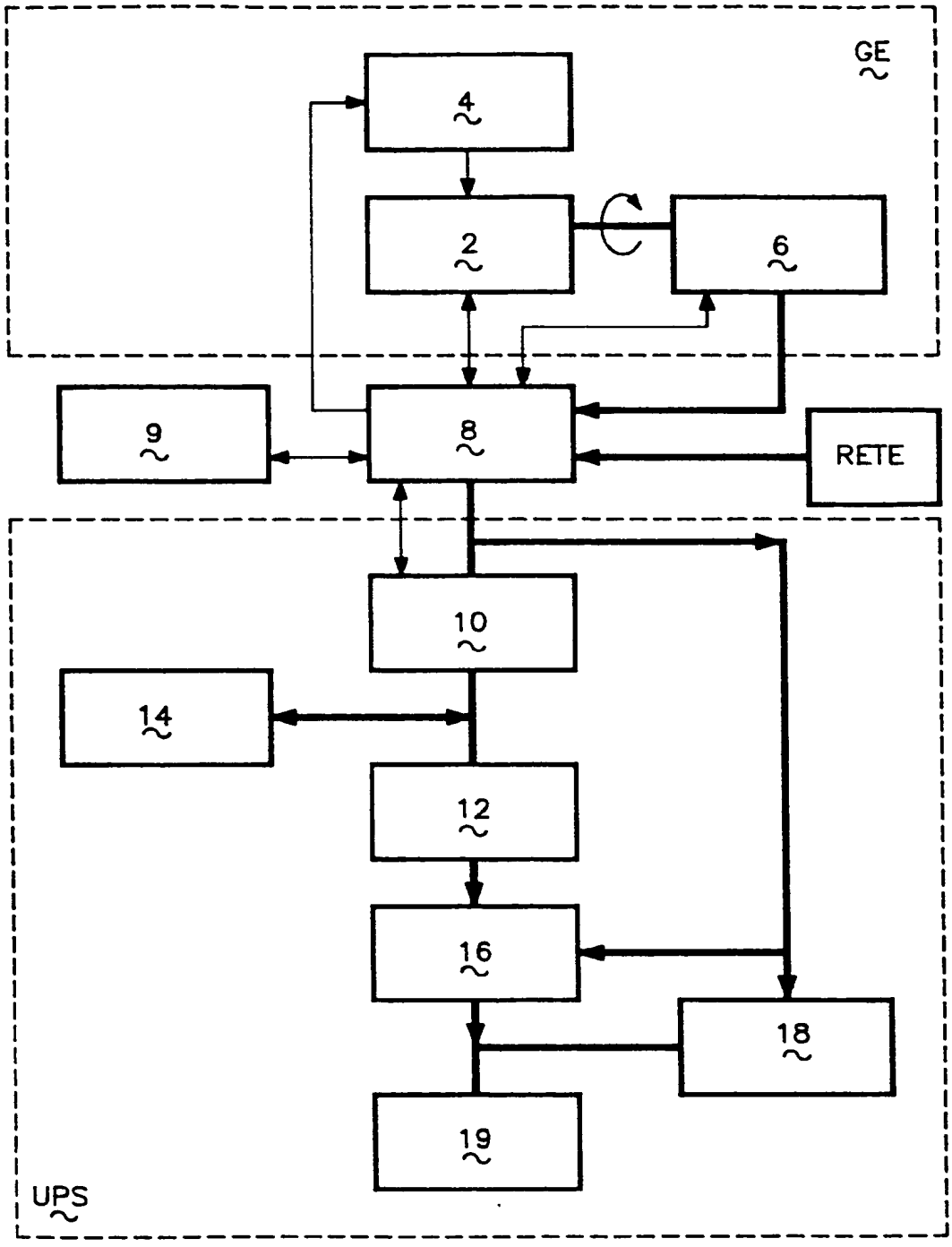

FIG. 3

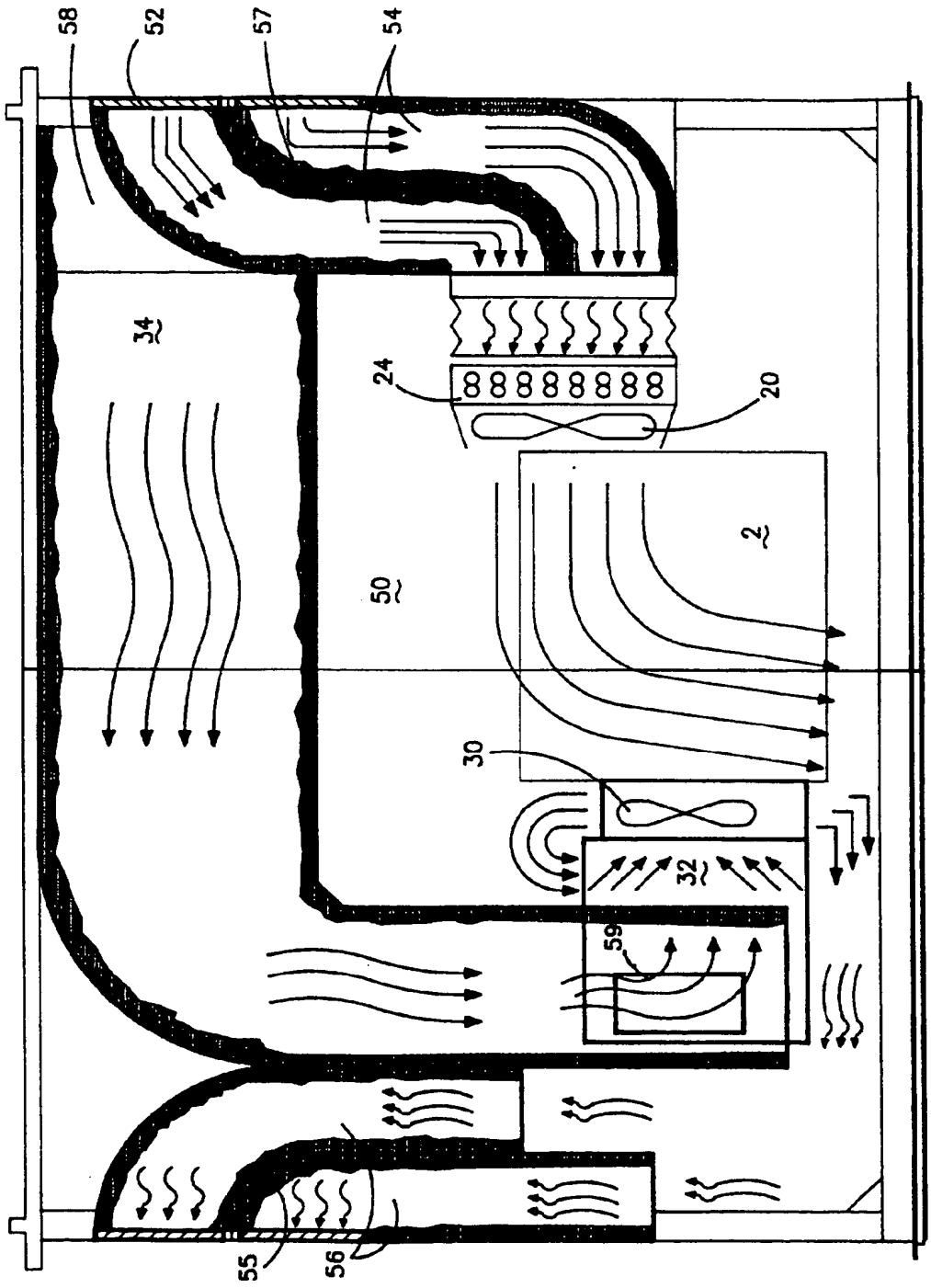

FIG. 4

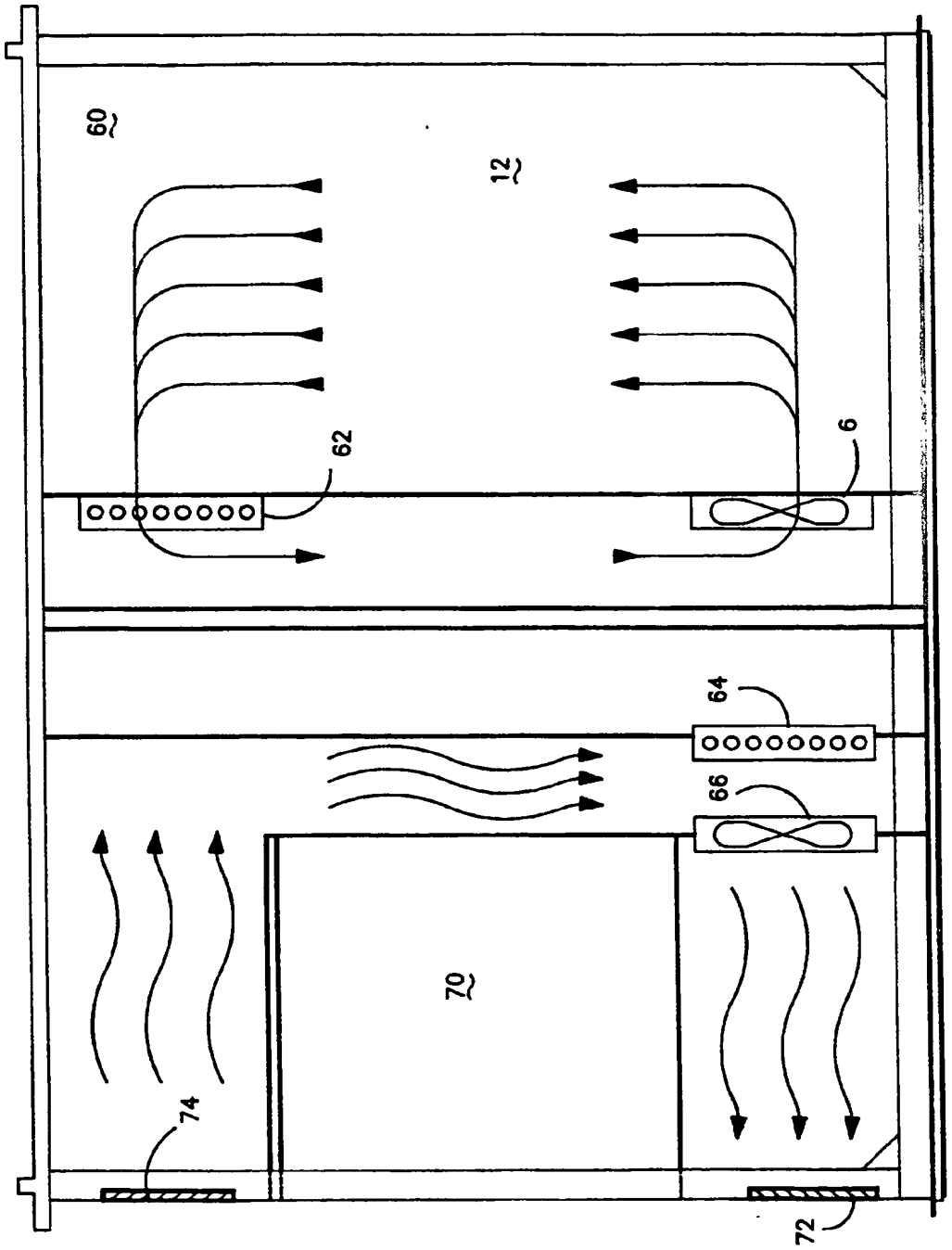

FIG. 5

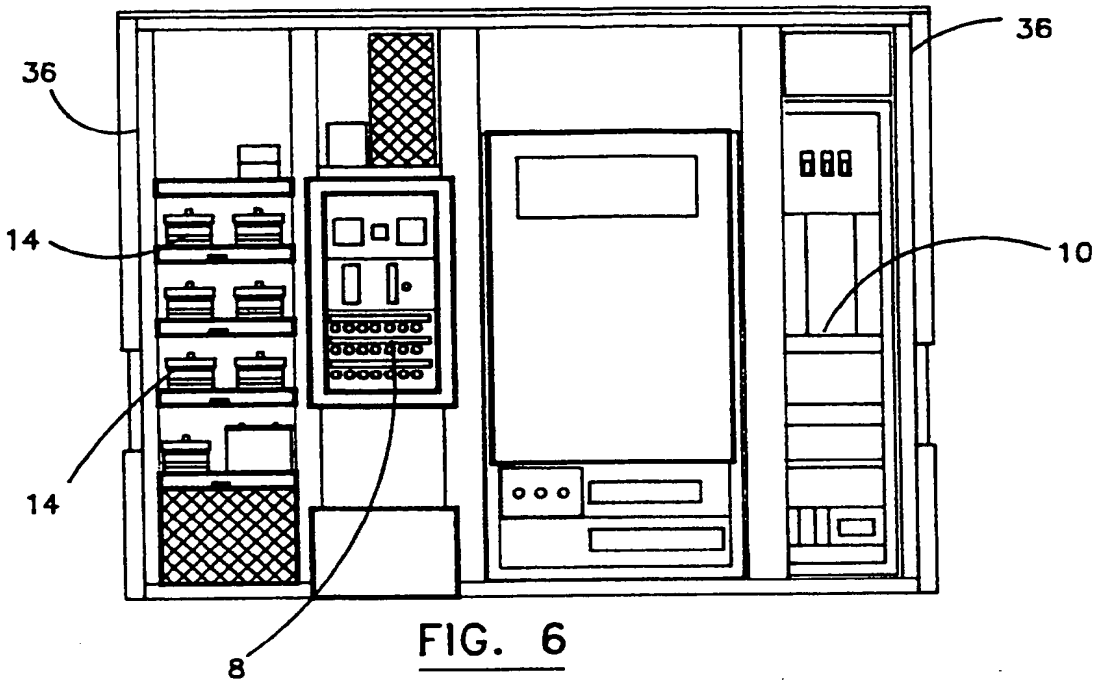

FIG. 6

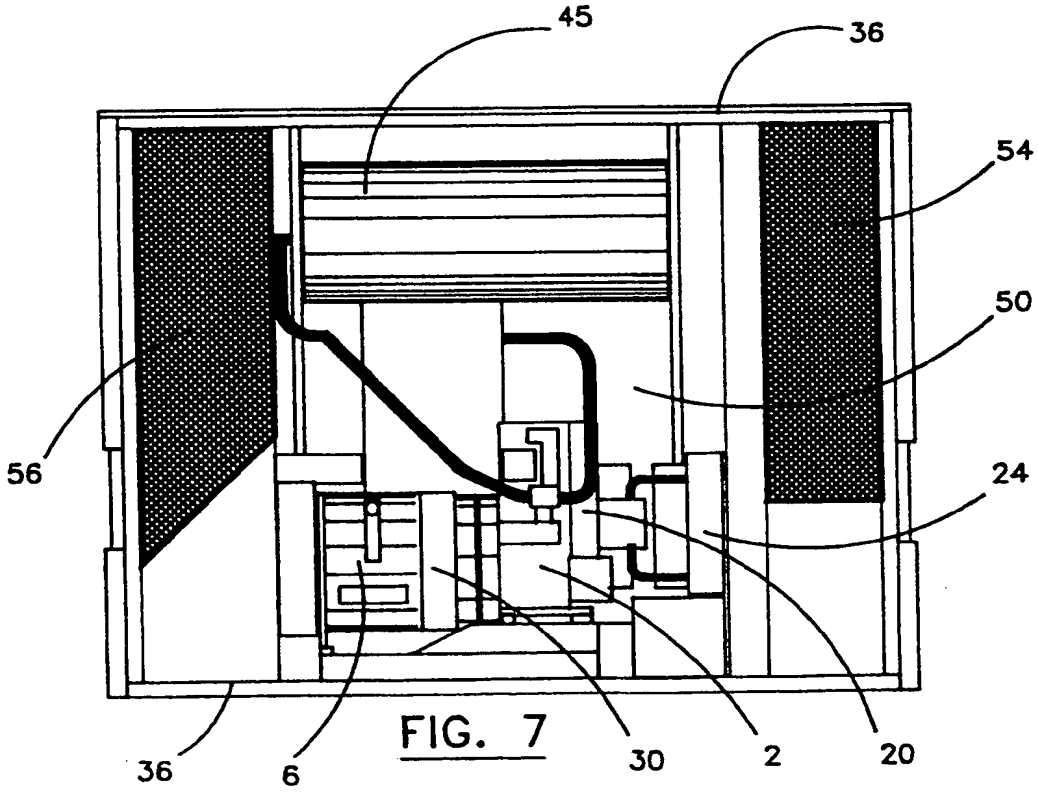

FIG. 7